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Comparison Between Score for Neonatal Acute Physiology Perinatal Extension II and Clinical Risk Index for Babies in Prediction of Neonatal Mortality in Septic Preterm Cases Tanta University Hospital's Neonatal Intensive Care Unit

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Preterm birth (< 37 weeks gestation) is a major cause of death and a significant cause of long-term loss of human potential amongst survivors all around the world.
Aim: Compare between two neonatal mortality risk scores, Score for neonatal acute physiology perinatal extension (SNAP-PE II) and Clinical risk index for babies (CRIB), in predicting the neonatal mortality in septic preterm admitted to neonatal intensive care unit (NICU) of Tanta University Hospital (TUH) over a period of one year.
Patients and Methods: This was a prospective cohort study carried out on 200 septic preterm newborns admitted to NICU of TUH over 1 year period. 89 cases representing (44.5 %) were female and 111 cases representing (55.5%) were male. All of them were admitted to NICU [within their first 48 hours of birth]. All septic preterm neonates will be followed up till their death or

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discharge. SNAP-PE II and CRIB scores applied to all the septic preterm neonates in this study during the first 12 hours after diagnosis of sepsis in NICU according to Modified Hematological scoring system (MHSS).
Results: There was a weak positive correlation between MHSS score for neonatal infection and both of the SNAP II and CRIB scores.
Conclusion: Both SNAP-PE II and CRIB scores have good sensitivity for predicting neonatal mortality which was slightly higher in SNAPPE II score. Neonatal Mortality rate was significantly correlated with high MHSS.

Keywords: Preterm neonate; SNAP PEII; CRIB score; mortality.

1. INTRODUCTION

SNAP assesses the worst clinical status found in the first 24 hours after admission using points assigned to 26 physiological variables: the higher the score, the greater the risk of death. With the Score for Neonatal Acute Physiology Perinatal Extension (SNAP-PE), 3 additional variables were added: birth weight, the APGAR score, and being small for gestational age [1].

The CRIB score was created to predict mortality for infants depending on birth weight, gestation, congenital malformation, and other factors [2]

The aim of this study is to compare between two neonatal mortality risk scores, Score for neonatal acute physiology perinatal extension (SNAP-PE II) and Clinical risk index for babies (CRIB), in predicting the neonatal mortality in septic preterm admitted to neonatal intensive care unit (NICU) of Tanta University Hospital (TUH) over a period of sone year.

2. PATIENTS AND METHODS

This study was carried out on 200 septic preterm newborns admitted to NICU of Tanta university hospital (TUH) over 1 year period, all of them were admitted to NICU [within their first 48 hours of birth].

- **Inclusion criteria:**

All neonates were followed up till their death or discharge.

- ✓ The patients of this study were all preterm neonates who were admitted to NICU and diagnosed to have septicemia defined as clinical signs and either blood culture or sepsis screen positive (CBC, CRP, urine analysis, urine culture and CSF analysis) or radiological evidence of pneumonia) in selected cases with evidence of systemic inflammatory response syndrome (SIRS) and organ dysfunction (OD) over one year period [3]
- ✓ All septic preterm neonates were followed up till their death or discharge.

- **Exclusion criteria:**

Patients The neonates who have one of the following criteria were excluded:

1- Full term births (gestational age ≥37 weeks)
2- Those who born outpatient (APGAR score not know)
3- Chromosomal anomalies

All patients parents provided written informed consent according to a protocol approved by ethical committee of Tanta faculty of Medicine. Adequate provisions to maintain privacy of participants and confidentiality of data were taken.

Data was collected from each case including the following:

- Gestational age, on the basis of the date of the last menstruation and new Ballard score , they will be divided into 4 groups (*less than 30 weeks, 30-32 weeks, 33-34 weeks and 35-36 weeks*).
- Sex *(male or female*).
- Birth weight will be obtained by electronic scale and grouped as follows:(*less than 1500 grams, 1500-1999 grams, 2000-2499 grams and 2500 grams or more*).
- ✓ Clinical manifestations suggestive of neonatal sepsis was defined by using **Brazilian National Surveillance Agency [4].** In which neonatal sepsis defined as systemic response, without any other recognized cause than infection, associated with at least two or more of the following signs and symptoms:

- Thermal instability,
- Apnea,
- Worsening of respiratory discomfort,
- Hemodynamic instability,
- Bradycardia,
- Feeding intolerance,
- Glucose intolerance,
- Hypoactivity and lethargy

SNAP-PE II and CRIB scores applied to all the neonates in this study during the first 12 hours after their admission to NICU as shown in table (1).(2) Final score was computed as arithmetic sum of points assigned to each item and after the SNAP-II PE score was calculated we divided it into 5 groups:

1. 0-9 points
2. 10-19 points
3. 20-29 points
4. 30-39 points
5. ≥40 points [5]

Table 1. Modified Hematological scoring system was applied to all preterm cases once clinical sepsis suspected as follows: [6]

Each CRIB score variable has a predetermined numerical value that varies according to severity once the total value of these items is defined, the patients are classified into four levels: Table 3

- ✓ Level 1 for scores from 0 to 5.
- ✓ Level 2 from 6 to 10.
- ✓ Level 3 from 11 to 15.
- ✓ Level 4 for scores higher than 15.

(International Neonatal Network, 1993) [7]

- Sepsis work up:

1. **Blood culture**: The volume of blood needed for cultures 0.5 ml was traditionally considered the standard volume of blood adequate to detect bacteremia in neonates.
2. **CRP:** was done to all neonates to detect sepsis.

- Liver function test:

AST (aspartate aminotransferase), ALT (alanine aminotransferase)

- Kidney function test:

Blood urea, Blood creatinine

Table 1. Modified Hematological scoring system

Parameter	Value	Mod HSS
Total leucocyte count	< 5000	2
	>25000 (at birth)	1
	> 30000 (12 - 24 hours)	1
	> 21000 (day 2 onwards)	1
	Normal	0
Total neutrophil count	No neutrophils	2
	Increased / decreased	1/2
	Normal (1800 - 5400/cumm)	0
Immature: total neutrophil ratio (IT ratio)	> 0.2	1
	< 0.2	0
Degenerative changes	Present	1
	Absent	0
Platelet count	<150000	1
	>150000	0

Table 2. Score for neonatal acute physiology perinatal extension (SNAPII –PE) scoring system [5]

Factor		Score
BP (mmHg)	>=30	0
	20-29	9
	20	19
Temperature (^{0}C)	>=35.6	0
	35.0-35.5	8

Factor		Score
	<35	15
	>=2.50	0
PaO_2/FIO_2	1.00-2.49	5
	0.30-0.99	16
	<0.30	28
	>=7.20	0
Serum PH	7.10-7.19	7
	<7.10	16
Seizure	None/single	0
	Multiple	19
	>=0.91	0
Urine output (ml/Kg/hr)	0.10-0.90	5
	<0.10	18
	>=1000	0
Birth weight (gm)	750-999	10
	<750	17
Small for gestational age	No	0
	Yes	8
Apgar score at 5 minutes	7-10	0
	<7	18
Total Score	Group 1	0-9
	Group 2	10-19
	Group 3	20-29
	Group 4	30-39
	Group 5	40=<

Table 3. Clinical risk index for babies (CRIB) (International Neonatal Network, 1993) [7]

Variable	Score
Birthweight (g)	
>1,350	0
851-1,350	1
701-850	4
≤700	7
Gestational age (weeks)	
>24	0
≥24	1
Congenital malformation	
None	0
No imminent life threatening	1
With imminent life threatening	3
Maximum BE during first 12h of life (mmol/l)	
>-7.0	0
-7.0 ta-9.9	1
-10.0 to-14.9	2
≤15.0	3
Minimal appropriate FiO_2, during first 12h of life	
≤0.40	0
0.41-0.60	2
0.61-0.90	3
0.91-1.00	4
Maximum appropriate FiO_2 during first 12h of life	
≤0.40	0
0.41-0.80	1
0.81-0.90	3
0.91-1.00	5

2.1 Statistical Analysis

In the ROC curve, the best cut off point is estimated when we get a maximum sensitivity (with true positive results) with a minimum false positive results at same cut off point.

3. RESULTS

- According to study, 89 cases representing (44.5%) were female and 111 cases representing (55.5%) were male,
- Regarding to birth weight of the cases included in our study there were about (14.0%) of the cases < 1000 gm, (39.5%) from 1000-1499 gm, (21.5%) from 1500-1999 gm and (25%) from 2000- 2500 gm.
- Regarding the gestational age groups, there were about (12 %) was included in this study < 30 week, (45.5 %) from 30-32 weeks, (31.5%) from 33-34weeks and (11%) from 35-36 weeks
- Regarding the initial diagnosis of the cases were included in the study, there is (100%) Respiratory, (34%) Cardiac, (7 %) metabolic (2.5%) Surgical, (10.5%) Neurological.
- According to MHSS sepsis is unlikely in 61.5% of cases,34% sepsis is possible and only 4.5% sepsis is very likely.
- Mortality rate in our study was when sepsis is unlikely 10.6% died and when sepsis is likely 54.50% died with 27.5% of total neonates died.

As regards SNAP-PEII groups in relation to outcome of the studied patients were proved to be statistically significant in unlikely and likely septic cases (P value =0.001), (P value =0.001).

As Table 4 showed that as the groups increased in severity from group (1) to (5) the neonatal mortality increased. as in group (4) in unlikely septic cases 47.1% died 52.9% discharged while 92.9% died 7.1% discharged in likely septic cases.

As regards CRIB groups in relation to outcome of the studied patients were proved to be statistically significant in unlikely and likely septic cases (P value =0.001), (P value =0.001).

As showed that as the groups increased in severity from group (1) to (4) the neonatal mortality increased as shown in Table 5.

4. DISCUSSION

Scoring systems involve using demographic, physiological and clinical data collected on the infant to calculate a score that quantifies its mortality and morbidity. The illness severity scores were thus developed with the aim of quantifying the clinically obvious fact that infants of the same gestational age and birth weight maintain greater mortality risk. The desirable properties of neonatal scores have been described as ease of use, applicability in the early course of hospitalization, ability to predict

Table 4. Relationship between Groups of SNAPPE II scores and outcome of newborns

	Neonatal outcome among cases with low MHSS score (sepsis is unlikely) N=123		**Neonatal outcome among cases with high MHSS score (sepsis is possible &likely) N=77**	
	Discharged N=110	**Died N=13**	**Discharged N= 35**	**Died N=42**
Group1 (0-9)	60	1	15	0
	98.4%	1.6%	100.0%	0.0%
Group 2 (10-19)	21	0	7	4
	100.0%	0.0%	63.6%	36.4%
Group 3 (20-29)	13	2	7	8
	86.7%	13.3%	46.7%	53.3%
Group 4 (30-39)	7	2	4	4
	77.8%	22.2%	50.0%	50.0%
Group 5 (≥ 40)	9	8	2	26
	52.9%	47.1%	7.1%	92.9%
Mont Carlo test / Chi square test	P = 0.001*		X2 = 36.12	P = 0.001*

Table 5. Relationship between CRIB scores and outcome of newborns admitted to NICU

	Neonatal outcome among cases with low MHSS score (sepsis is unlikely) N=123		Neonatal outcome among cases with high MHSS score (sepsis is possible &likely) N=77	
	Discharged N=110	**Died N=13**	**Discharged N= 35**	**Died N=42**
Group 1 (0-5)	92	3	30	14
	96.8%	3.2%	68.2%	31.8%
Group 2(6-10)	14	4	4	15
	77.8%	22.2%	21.1%	78.9%
Group 3 (11-15)	4	6	1	13
	40.0%	60.0%	7.1%	92.9%
Mont Carlo test	P 0.001*		X2 =22.02	P = 0.001*

mortality categories of the neonates, and usefulness for all groups of neonatal infants [8].

Diagnosis of neonatal sepsis at an early stage substantially reduces the mortality. The clinician often relies on laboratory parameters to support the clinical suspicion. As blood culture takes time and yield is low, hematological and biochemical parameters often guide to the diagnosis and management. Rodwell's Hematological sepsis score (HSS) has a reasonable sensitivity but low specificity. Some of the parameters included in that scoring system are repetitive of same pathogenic mechanism. A modified HSS was developed by removing the repetitive parameters [9].

In our study, sepsis is unlikely in 61.5% of cases, 34% sepsis is possible and only 4.5% sepsis is very likely according to MHSS.

Mortality rate in our study was when sepsis is unlikely 10.6% died and when sepsis is likely 54.50% died with 27.5% of total neonates died. The higher MHSS the higher mortality rate.

This result came in agreement with *Asker et al.,* their study was done in southern Turkey from July 2012 to July 2013. Total, 1688 of 1743 infants (55 were excluded for congenital anomaly, 3.2%) were included. One hundred and eighty-eight (188) out of the 1668 babies died (mortality rate, 11.3%) [10].

In our study, as regards SNAP PE II groups in relation to outcome of the studied patients were proved to be statistically significant as the (P value =0.001) in unlikely and likely septic cases, as the groups increased in severity from group (1) to (5) the neonatal mortality increased.

This is in agreement with a study conducted by Mia et al. [11] a score of 30 and above, Study by Suksham Jain and Anuradha Bansal [12] scores of 40 and above, study done by Ucar et al. [13] scores of 33 and above were associated with higher mortality .

Mia et al. [11] the study done at Soetomo Hospital, Surabaya: the sample size calculation was 80 neonates. During a study period of four months, 80 neonates were evaluated and the necessary investigations for scoring the SNAPPE II were done within 12 hours of admission the mean of SNAPPE II was 26.3±19.84 (range 0-81). The SNAPPE II of the non -survivals was significantly higher than the survivals (42.75±18.59 vs 17.4±14.05). They showed that the SNAPPE II value of the non-survivals was significantly higher than the survivals. Neonates with SNAPPE II <10 have only a mortality of 5%, but SNAPPE II >60 was suggestive of poor outcome with mortality 100%.

In our study, reveals that only one of the SNAPPE II parameter was a significant predictor for death among cases with high MHSS score; the PH level of (7.10 -7.19) P= 0.046 while only two of the SNAPPE II parameters were significant predictors for death among cases with low MHSS score; multiple seizures and low birth weights (P=0.005 & 0.027).

In our study, as regard to CRIB groups in relation to outcome of the studied patients were proved to be statistically significant in unlikely and likely septic cases (P value =0.001), as the groups increased in severity from group (1) to (4) the neonatal mortality increased. And this came in agreement with study was done by *Sarquis et al.,* score was obtained through a prospective way from 100 newborns with birth weight of 1,500 g

or less or gestational age less than 31 weeks, who were admitted consecutively to the Neonatal Unit of Hospital das Clínicas, Universidade Federal do Paraná. 55 newborns were females and 45 were males, the average birth weight was 1,078 +/- 0.277 g and gestational age was 29.2 +/- 2.8 weeks. Twenty-one patients died. The mortality rate in the CRIB groups 1, 2, 3 and 4 was, respectively 6.6%; 46.2%; 87.5% and 100.0% [14].

Also *this study* came in-agreement with the study was done by *Courcy et al.,* in which The South East Thames Low Birthweight, Study collected data on all infants with a birth weight between 500 and 2499 g and born to mothers resident in the region between 1 September 1992 and 31 August 1993. CRIB score was significant as a predictor of hospital mortality (P<0.0001). For example, mortality in hospital ranged from 3% (14/464) with a CRIB score of 0-5 to 94% (15/16) with a score >15 [15].

In our study, reveals that that two of the CRIB parameters were significant predictors for death among cases with high MHSS score; low birth weights and Lower levels of Base excess (P =0.031,.016,.040 and.002) while that None of the CRIB parameters were a significant predictor for neonatal deaths among cases with low MHSS score.

Our study revealed that both the areas under the ROC curve for SNAP PE II and CRIB scores were nearly similar but the accuracy for SNAP II was more than the accuracy for CRIB score. They were (0.885 and 0.860) respectively with standard errors of (0.037, 0.041) respectively. Accuracy of both scores were considered good for prediction of neonatal mortality among neonates with high MHSS scores. And this came in agreement also with *Zardo and Procianov* [16] who investigated the CRIB, SNAP-PE, and SNAP-PE-II scoring systems The survey included 494 newborns admitted to the neonatal intensive care unit (NICU) of a general hospital in Porto Alegre, southern Brazil, immediately after delivery, between March 1997 and June 1998. They found that no system was statistically superior over another with respect to AUC. The area below the ROC curves ranged from (0.81 to 0.94). There were no statistically significant differences between the areas obtained for all scores evaluated and that the predictive value of the three systems increased with birth weight. The authors concluded that CRIB, SNAP-II, and SNAP-PE-II are useful because they are easily applied if the results are obtained at an early stage or within a short time, within the first 12 h of admission.

On contrary, in the study was done by Asker et al. [10] they compared these two scoring systems (SNAPPE II and CRIB) in newborns with GA <32 weeks and birth weight < 1500 g. SNAP PE-II (AUC, 0.74) had a higher predictive value than the CRIB system (AUC, 0.54). The most important difference between SNAP-PE-II and CRIB is that the former does not contain the parameter of gestational weeks; instead, it contains more parameters related to the emergency condition of the infant requiring intervention. This may explain why SNAP-PE-II had a higher predictive value in the present study [10].

Also the current study proved that, that there was a weak positive correlation between MHSS score for neonatal infection and both of the SNAPPE II and CRIB scores (r = o.390 & 0.309) respectively. So this means that as the MHSS score increase, the SNAPPE II and the CRIB scores also increase. The observed correlation was statistically significant for both scores (p= 0.001).

5. RECOMMENDATIONS:

1-Both scores could be routinely applied in all NICUs for predicting neonatal mortality. 2-Similar study including the use of both scoring systems could be applied on different neonatal illness. 3-Wide scale study using different scoring systems for predicting the neonatal outcome.

6. CONCLUSION

Both SNAP-PE II and CRIB scores have good sensitivity for predicting neonatal mortality which was slightly higher in SNAPPE II score. Neonatal Mortality rate was significantly correlated with high MHSS when sepsis is likely increased than when sepsis is unlikely.

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

CONSENT

All patients' parents provided written informed consent according to a protocol approved by

ethical committee of Tanta faculty of Medicine.

FUNDING

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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